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Effects of Cooperative Active Learning Experiences on Achievement, Attitudes, and Behaviours in Biology

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Abstract

It has been reported that with age, learners' interest in science is reduced [1]. Learners' attitudes towards science and how pupils learn science content considerably influences their tendency towards attainment and their ability to retain science information, inside and outside of school. Vogel and Wanke [2] state that an attitude is "a summary evaluation of an object or thought". Koballa and Glynn [3] describe attitudes as the expression of positive or negative affects towards objects, and this differentiates attitudes from other expressions, such as beliefs, values, or opinions. The aim of this research is to determine the impact of the implementation of cooperative learning on student's attitude and behaviour towards biology. Cooperative Learning (CL) concerns instructional methods in which a small group of learners with various levels of ability work together to achieve mutual goals. The study took place in Ireland and it involved pre-service teachers in their second year of their Biology teacher education programme and students from secondary school (junior cycle). In order to achieve the research aims, quantitative (student questionnaire) and qualitative methods (pre- service teacher interview) were applied. The participants were ten pre-service teachers who received training workshop on using CL, along with their 402 junior cycle students. The findings indicate that the majority of junior cycle students in this study showed positive attitudes towards biology after the implementation of cooperative learning methods.

Keywords: *Cooperative, learning, Biology, attitudes.*

Introduction

In the last two decades, many research studies have investigated learners' attitudes towards science in science education [4,5,6,7]. The importance of attitudinal studies, primarily attitudes towards science, is not a new field in science education [8]. Many of the studies on attitude towards science have mostly focused on science in general rather than addressing specific disciplines within the sciences [9]. This can confuse learners' attitudes because science is not one homogeneous course [10]. However, there are some studies that examine this term in specific science disciplines, such as chemistry, physics, and biology. For instance, Bennett [11] evaluated secondary students' attitudes towards chemistry; Krogh and Thomsen [12] did some similar studies on physics; and Nasr and Soltani [13] assessed students' attitudes towards biology.

Method

Mixed methods research bridges the gap between quantitative and qualitative research ([14]. The aim of mixed methods research is not to replace any approach, but to take advantage of the strengths of both while reducing their weaknesses. The diversity of mixed methods research can add strength to the collected data [15]. The aim of this research is to measure the effect of active cooperative learning in biology on student's (Junior Cycle) attitude. This study collected quantitative and qualitative data through questionnaire and personal interviews (see table 1.1). The student pre and post-surveys were used to evaluate students attitudes of Biology before and following a CL intervention programme.

Table 1.1 The breakdown of the number of undergraduate students involved in the survey according to gender

	Junior cycle biology students
Number of Female responses	211 (52.5%)
Number of Male responses	191 (47.5%)
Total number of responses	402

Intervention Programme (Jigsaw Techniques)

In this study the researcher used the jigsaw technique which is one of the most effective CL methods in the intervention programme. The jigsaw strategy is a method of planning classroom activity where

pupils rely on each other for success. Jigsaw techniques are used for many purposes in teaching and learning [16], so it has gained the attention of researchers, teachers, and school directors [17]. Jigsaw IV, developed by Holliday [18], where each group in this technique consists of five or six heterogeneous members; each group member is given a topic to learn and then they discuss the material with students from other groups who worked on the same information- called an “expert group.” Students from the expert area return to their team and present their information to other group members. Finally, after the expert members finish their explanation, the whole group is given a quiz to check their understanding.

Results

This section shows the main findings from the analysis of the results of pre and post-surveys for the CL groups. The students in the CL groups engaged in the cooperative learning lessons (jigsaw method) and completed a post-survey at the end of the intervention programme. The main aims of the pre and post-surveys were to determine whether the intervention programme has changed students’ attitude and behaviour towards Biology.

Practical work in Biology

Table 1.2 shows that the percentage of agreements of students’ attitude toward practical work. At the beginning of the intervention programme, most of the students agreed on the positive item (2) and disagreed on the negative items (5, 7, and 8) of practical work (see Appendix 1). The analysis of individual items on the pre- and post-questionnaires showed that students had a very positive attitude toward the importance of carrying out practical work in order to understand biology module (increased from 66.6% to 83.9%). The level of disagreement of negative statements such as “the anxiety about doing practical work with other members” increased from 63.5% to 85.4%, “doing biology practical work is a waste of time” increased from 84.3% to 96.8%, and “learning biology practical work is useless in daily life” from 54.2% to 82.2%.

Table 1.2: CL group attitude toward Practical Work in Biology before and after the implementation of the study (Paired-sampleT test)

Item	**pre-survey**			**post-survey**				
Item	**Strongly Agree (5) Agree (4)**	**Disagree (2) + Strongly Disagree (1)**	**Uncertain (3)**	**Strongly Agree (5) Agree (4)**	**Disagree (2) + Strongly Disagree (1)**	**Uncertain (3)**	**Mean Pre/ post**	**P-value Pre-post**
1	66.6%	13.5%	19.8%	83,9%	5.2%	11.4%	3.81/ 4.03	0.003
2	20.85	63.5%	15.6.%	3.1%	85.4%	11.4%	2.35/ 1.85	0.0005
3	9.3%	84.3%	6.2%	2%	96.8%	1%	1.83/ 1.64	0.001
4	18.7%	54.2%	27.1%	3.1%	82.2%	14.5%	2.41/ 1.96	0.0001

The students’ responses showed that most students in the CL group increased their attitude toward practical work following the intervention programme. It was clear that there was significant difference in students attitude toward practical work.

Importance of Biology

According to the results shown in Table 1.3, the level of agreement for item one (Knowledge of Biology is necessary to understand other subjects and phenomena) increased from 71.8% to 87.5%,

and in item three, from 59.3% to 79.1%. The result showed that there was a significant difference in students' attitude toward the importance of Biology.

Table 1.3: CL group attitude toward Importance of Biology before and after the implementation of the study (Paired- samples T test)

Item	**pre-survey**			**post-survey**				
Item	**Strongly Agree (5) Agree (4)**	**Disagree (2) + Strongly Disagree (1)**	**Uncertain (3)**	**Strongly Agree (5) Agree (4**	**Disagree (2) + Strongly Disagree (1)**	**Uncertain (3)**	**Mean Pre-post**	**P-value Pre- post**
1	71.8%	8.3%	19.8%	87.5%	4.1%	8.3%	3.84 / 4.19	0.006
2	78.1%	1%	20.8%	80.2%	2%	17.7%	4.05 / 4.11	0.617
3	59.3%	8.3%	32.3%	79.1%	4.1%	16.6%	3.70 / 3.95	0.033

Self-concept in Biology

The last subsection in students' attitude toward Biology was self-concept in Biology (see Table 1.4). When the agreement, disagreement, mean score, and the p-value from the pre- questionnaire were compared with the post-questionnaire, it was clear that there was a significant difference. The mean scores in positive items from pre-questionnaire were 4.00 (item 1), 3.23 (item 3), and 3.41 (item4) while the mean scores of the same items from post-questionnaire were 4.31, 3.44, and 3.77 with the p-value 0.0005 , 0.0003, and 0.0001 respectively. The percentage of agreement in positive items (1, 3, and 4) increased from 80.2%, 33.3%, and 54.2% to 93.7%, 54.1%, and 76%, and the percentage of disagreement in the negative item (item 2) increased from 68.7%to 89.5%.

Table 1.4: CL group attitude toward Self-concept in Biology before and after the implementation of the study(Paired- samples T test)

Item	**pre-survey**			**post-survey**				
Item	**Strongly Agree (5) Agree (4)**	**Disagree (2) + StronglyDisagree (1)**	**Uncertain (3)**	**Strongly Agree (5) Agree (4)**	**Disagree (2) +StronglyDisagree (1)**	**Uncertain (3)**	***Mean Pre/ post***	**P-value**
1	*80.2%*	*6.2%*	*13.5%*	*93.7%*	*1%*	*5.2%*	*4.00/ 4.31*	0.0005
2	*16.7%*	*68.7%*	*14.6%*	*4%*	*89.5%*	*6.2%*	*2.27/ 1.92*	0.0004
3	*33.3%*	*18.7%*	*47.9%*	*54.1%*	*18.7%*	*27%*	*3.23/ 3.44*	0.0003
4	*54.2%*	*17.7%*	*28.1%*	*76%*	*9.3%*	*14.5%*	*3.41/ 3.77*	0.0001

In general, students from the experimental group increased their attitude toward practical work, impotence of Biology and self-concept in Biology after applying the intervention programme on the CL groups.

Discussion and Conclusion

There was a very significant change in students' attitude toward Biology in the post-survey results. The author believes that the CL lessons have helped learners to change their attitude toward Biology

by giving the students opportunity to communicate, interact, and gain positive interdependence in their work group**.** The results show that the implementation of cooperative learning methods on biology class has advantages on students' attitude. The students' responses illustrated that most students in the experimental group showed an increased attitude toward practical work, importance of Biology and self-concept in Biology following the intervention programme. Süleyman [19] noted that students in the CL group improved more in positive attitudes toward the subject than the students in the traditional method group. This might be due to the presence of assistance and support within the group, active involvement, and higher chances of success that are associated with cooperative learning technique. Tuan et al [20] stated that there is a strong relationship between students' science attitude and motivation, and to achieve a high level of motivation, we should stimulate learning environments because it has a higher connection with student's attitude toward science. Eilks [21] reported that students in jigsaw classrooms have positive opinions toward science lessons because they have the opportunity to work in groups and as individuals. Jigsaw methods increase learners' attitude toward science, positive cognitive achievement, improves their communication skills, and improves the teaching quality of science.

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Appendix 1

	Item	**Statement**
Practical work in Biology	Item 1	I need to carry out practical work in order to understand biology module.
	Item 2	I feel anxious when I am doing biology practical work because I have to work with other members.
	Item 3	Doing biology practical work is a waste of time
	Item 4	What I learn from biology practical work is useless in daily life
Importance of Biology	Item 1	Knowledge of biology is necessary to understand other subjects and phenomena.
	Item 2	Understanding biology makes our life easier.
	Item 3	Biology is helpful in solving the problems of everyday life.
Self-concept in Biology	Item 1	Knowledge of biology changes my opinions about how the natural world works.
	Item 2	In biology class, I feel anxious.
	Item 3	I feel more relaxed in a biology class than in any other class.
	Item 4	I learn biology quickly and easily.